

In re Patent Application of:  
**DI BERNARDO ET AL.**  
Serial No. **09/747,786**  
Filing Date: **December 22, 2000**

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**REMARKS**

Applicants would like to thank the Examiner for the thorough examination of the present application. The specification has been amended to correct a minor grammatical error. The arguments supporting patentability of the claims are provided in detail below.

**I. Independent Claims 9 And 25 Are Patentable**

Independent Claims 9 and 25 have been rejected over the Abarbanel et al. patent. The present invention, as recited in independent Claim 9, for example, is directed to a communication system comprising a transmission channel, a signal source for providing a discrete signal, and a chaotic modulator for modulating the discrete signal for transmitting over the transmission channel. An incoherent discriminator receives the modulated discrete signal from the transmission channel. The use of an incoherent discriminator in accordance with the present invention advantageously allows the discrete signal to be reconstructed using a structure that is different than the structure used to modulate the discrete signal for transmitting over the transmission channel.

Independent method Claim 25 is similar to independent device Claim 9, and is directed to a method for transmitting a signal over a transmission channel as discussed above.

Referring now to FIGS. 1 and 5 in the Abarbanel et al. patent, Abarbanel et al. discloses a communication system in which a chaotically generated signal is modulated using a transmitter chaotic signal generator **20, 46**. After transmission, the received signal is applied to a receiver

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chaotic signal generator **30, 54**, and the chaotic signal is recovered. The chaotic signal is used to demodulate the received signal for recovery of information.

The Applicants respectfully submit that the receiver in the communication system in Abarbanel et al. does not include an incoherent discriminator as in the claimed invention. First, Abarbanel et al. does not make any reference to the receiver having an incoherent discriminator for receiving the modulated digital signal from the transmission channel.

Second, in Abarbanel et al., after transmission over the transmission channel, the received signal is applied to a receiver chaotic signal generator **32** that is substantially identical to the transmitter chaotic signal generator **18**, as illustrated in FIG. 1. In FIG. 5, the combined analog/digital chaotic generator **44** in the transmitter is substantially identical to the combined digital/analog chaotic generator **56** in the receiver. Since the chaotic modulator in the transmitter is substantially identical to the corresponding demodulator in the receiver, Abarbanel et al. fails to disclose that the receiver may include an incoherent discriminator for receiving the modulated signal from the transmission channel. In fact, Abarbanel et al. teaches away from the use of an incoherent discriminator.

Therefore, the Applicants submit that independent Claim 9 is patentable over the Abarbanel et al. patent. Independent Claim 25 is similar to independent Claim 9, and it is submitted that this claim is also patentable over the Abarbanel et al. patent.

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## **II. Independent Claim 17 Is Patentable**

Independent Claim 17 has been rejected over the Abarbanel et al. patent in view of the Lee et al. article in further view of the Culter et al. patent. The present invention, as recited in independent Claim 17, is directed to a communication system comprising a digital signal source for providing a digital signal, a chaotic modulator for modulating the digital signal for transmitting over a transmission channel, and an incoherent discriminator for receiving the modulated digital signal from the transmission channel. The incoherent discriminator comprises a high-pass filter, a rectifier connected to an output of the high-pass filter, and a low-pass filter connected to an output of the rectifier. The communication system in accordance with the present invention advantageously operates in a noisy medium based upon a chaotic carrier.

Referring now to FIGS. 1 and 5 in the Abarbanel et al. patent, Abarbanel et al. discloses a communication system in which a chaotically generated signal is modulated using a transmitter chaotic signal generator **20, 46**. After transmission, the received signal is applied to a receiver chaotic signal generator **30, 54**, and the chaotic signal is recovered. The chaotic signal is used to demodulate the received signal for recovery of information. Still referring to FIG. 1, the Examiner characterized the bandpass filter **28** as a high-pass filter.

As correctly noted by the Examiner, Abarbanel et al. fails to disclose a rectifier connected to the high-pass filter **28**, and a low-pass filter connected to the rectifier. The Examiner cited the Lee et al. article as disclosing a

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rectifier, and the Culter et al. patent as disclosing a low-pass filter.

In the Lee et al. article, the Examiner characterized the disclosed noise reduction method for reducing the dynamic error of chaotic signals as performing the function of a rectifier. The Applicants respectfully submit that the Examiner has mischaracterized the Lee et al. article. The Culter et al. patent discloses a low-pass filter, but fails to make any reference to chaotic signals and rectifiers.

Even if the references were selectively combined as suggested by the Examiner, the claimed invention is still not produced. As discussed above, Abarbanel et al. teaches away from the use of an incoherent discriminator as in the claimed invention. Abarbanel et al. does not make any reference to the receiver having an incoherent discriminator for receiving the modulated digital signal from the transmission channel. Moreover, since the chaotic modulator in the transmitter is substantially identical to the corresponding demodulator in the receiver, Abarbanel et al. fails to disclose that the receiver may include an incoherent discriminator for receiving the modulated signal from the transmission channel.

As correctly noted by the Examiner, Abarbanel et al. fails to disclose a rectifier connected to the high-pass filter **28**, and a low-pass filter connected to the rectifier. The Lee et al. article discloses a secure communication system using a chaotic system. The secure communication system in Lee et al. does not require synchronization of the receiver to the transmitter because the power level of the dynamic error of each data stream is compared.

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In particular, Lee et al. discloses two chaotic systems generating similar waveform sequences, such as the Henon map (two-dimensional) and the Logistic map (one-dimensional). It is assumed that a data stream from the Henon map of length  $L$  represents a logic 0, and a data stream from the Logistic map of the same length represents a logic 1. The transmitter sends the information sequences composed of a consecutive data stream which may be generated by the Henon map or by the Logistic map. The power level of the dynamic error of each data stream is compared with a threshold to determine if a logic value of the received data stream is a 1 or a 0.

The Applicants acknowledge that Lee et al. makes reference to a correlation coefficient between  $x_n$  and  $y_n$ , where  $x_n$  is contaminated with additive noise  $w_n$ , and the noisy point is represented by  $y_n = x_n$  and  $w_n$ . Moreover, a correlation is performed to estimate the noisy point  $y_n$  to estimate the noise reduced point  $x_n$ . However, the Applicants do not see this noise reduction approach being performed between the output of a high-pass filter and an input of a low pass-filter as in the claimed invention. If the output of the correlation in Lee et al. determines the logic 0s and 1s of the received data stream, then why would it be necessary to connect these results to a low pass filter?

The Culter et al. patent discloses a low-pass filter, but fails to make any reference to chaotic signals and rectifiers. Consequently, the Applicants respectfully submit that even if the references were selectively combined as suggested by the Examiner, the claimed invention is still not produced.

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Applicants also respectfully assert that there is no proper motivation to modify the Abarbanel et al. patent in view of the Lee et al. article in further view of the Culter et al. patent in the manner set forth by the Examiner in an attempt to produce the claimed invention. Absent the Applicants' disclosure, one of ordinary skill in the art would not look to add a rectifier (as disclosed in Lee et al.) and a low pass filter (as disclosed in Culter et al.) to the high pass filter disclosed in Abarbanel et al.

This is particularly so since Abarbanel et al. does not make any reference to an incoherent discriminator for receiving the modulated digital signal from the transmission channel, as in the claimed invention. In Abarbanel et al., after transmission over the transmission channel, the received signal is applied to a receiver chaotic signal generator substantially identical to the transmitter chaotic signal generator and the chaotic signal is recovered.

More particularly, the receiver in Abarbanel et al. incorporates a bandpass filter tailored so that the chaotic output of the chaotic generator is compatible with the bandpass characteristics of the transmission link. The bandpass filter is also integrated into the chaotic generator so that upon transmission, the modulated chaotic generator output is not selectively attenuated or otherwise modified over the finite bandpass of the transmission link. Resultantly, after transmission over the communication link the receiver's chaotic demodulator, incorporating the same bandpass filter as the transmitting chaotic generator, synchronizes with the received chaotic signal allowing demodulation and recovery of the information signal.

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Applicants thus assert that only in hindsight, and having the benefit of the Applicants' disclosure, would the skilled artisan possibly be motivated to modify the Abarbanel et al. patent in view of the Lee et al. article in further view of the Culter et al. patent in the manner set forth by the Examiner. Therefore, the Applicants submit that independent Claim 17 is patentable over the Abarbanel et al. patent in view of the Lee et al. article and in further view of the Culter et al. patent.

### **III. Independent Claim 21 Is Patentable**

Independent Claim 21 has been rejected over the Abarbanel et al. patent in view of the Culter et al. patent in further view of the Giacomini patent and in further view of the Brenman et al. patent. The present invention, as recited in independent Claim 21, is directed to a communication system comprising a digital signal source for providing a digital signal, a chaotic modulator for modulating the digital signal for transmitting over a transmission channel, and an incoherent discriminator for receiving the modulated digital signal. The incoherent discriminator comprises a low-pass filter, a null-threshold comparator connected to an output of the low-pass filter for providing a square-wave output signal, and a divider connected an output of the comparator for scaling the square-wave output signal. The communication system in accordance with the present invention advantageously operates in a noisy medium based upon a chaotic carrier.

As noted above, Abarbanel et al. discloses a chaotic communication system. As correctly noted by the Examiner, Abarbanel et al. fails to disclose a low-pass filter, a null-

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threshold comparator connected to the low-pass filter, and a divider connected to the null-threshold comparator. The Examiner cited Culter et al. as disclosing the low-pass filter, Giacomini as disclosing the null-threshold comparator, and Brenman et al. as disclosing the divider.

Even if the references were selectively combined as suggested by the Examiner, the claimed invention is still not produced. As discussed above, Abarbanel et al. teaches away from the use of an incoherent discriminator as in the claimed invention. Abarbanel et al. does not make any reference to the receiver having an incoherent discriminator for receiving the modulated digital signal from the transmission channel. Moreover, since the chaotic modulator in the transmitter is substantially identical to the corresponding demodulator in the receiver, Abarbanel et al. fails to disclose that the receiver may include an incoherent discriminator for receiving the modulated signal from the transmission channel.

Applicants also respectfully assert that there is no proper motivation to modify the Abarbanel et al. patent in view of the Culter et al. patent in further view of the Giacomini patent and in further view of the Brenman et al. patent in the manner set forth by the Examiner in an attempt to produce the claimed invention. Absent the Applicants' disclosure, one of ordinary skill in the art would not look to add a low-pass filter (as disclosed in Culter et al.) and a null-threshold comparator (as disclosed in Giacomini) and a divider (as disclosed in Brenman et al.) to the high pass filter disclosed in Abarbanel et al.

Applicants thus assert that only in hindsight, and having the benefit of the Applicants' disclosure, would the



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skilled artisan possibly be motivated to modify the Abarbanel et al. patent in view of the Lee et al. article in further view of the Culter et al. patent in the manner set forth by the Examiner.

Therefore, the Applicants submit that independent Claim 21 is patentable over the Abarbanel et al. patent in view of the Culter et al. patent in further view of the Giacomini patent and in further view of the Brenman et al. patent. In view of the patentability of the independent claims as discussed above, it is submitted that their dependent claims, which recite yet further distinguishing features, are also patentable over the prior art. Thus, these dependent claims require no further discussion herein.


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**CONCLUSION**

In view of the arguments provided herein, it is submitted that all the claims are patentable. Accordingly, a Notice of Allowance is requested in due course. Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Respectfully submitted,

  
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